Use of Functional Data to Model the Trajectory of an Inertial Measurement Unit and Classify Levels of Motor Impairment for Stroke Patients

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摘要

Motor impairment evaluations are key rehabilitation-related assessments for patients with stroke. Currently, such evaluations are subjective; they are based on physicians' judgements regarding the actions performed by patients. This leads to inconsistent clinical results. Many inertial sensing elements for motion detection have been designed. However, to more easily and rapidly evaluate motor impairment, we require a system that can collect data effectively to predict the degree of motor impairment.

Lin et al. (2019) used data gloves equipped with an inertial measurement unit (IMU) to collect movement trajectories for motor impairment evaluations in patients with stroke. The present study used functional data analysis to model data trajectories to reduce the influence of noise from IMU data and proposed using coefficients of function as features for classifying motor impairment. To verify the appropriateness of feature construction, five classification methods were used to evaluate the extracted features in terms of the overall and sensor-specific ability to classify levels of motor impairment. The results indicated that the features derived from cubic smoothing splines could effectively reflect key data characteristics, and a support vector machine yielded relatively high overall and sensor-specific accuracy for distinguishing between levels of motion impairment in patients with stroke. Future data glove systems can contain cubic smoothing splines to extract hand function features and then classify motion impairment for appropriate rehabilitation programs to be prescribed.

Keyword: Functional data, inertial measurement unit, motor impairment, spline, stroke.